

A review of the long-term use of cyclododecane at Abydos

Lucy Skinner and Hiroko Kariya

Cyclododecane (CDD), first introduced at Abydos by an American conservation team in 1999, was used to block-lift archaeological wood from 5000-year-old ships. Following this success, CDD became a mainstay of the conservation tool kit, commonly used to aid block-lifting in the field and allowed to sublime in the field lab. CDD-coated artefacts have also been sealed and packed to prevent sublimation, exploiting it to consolidate objects between seasons, and allowing treatments to be completed in subsequent years. This paper is a review of treatment methodologies using CDD in the field at Abydos and discusses both successes and failures. Database records indicate that CDD has been used over 50 times at Abydos over 17 years, representing perhaps the most extensive, long-term use of CDD on archaeological sites. A programme set up in 2011 to monitor lasting effects of CDD on the artefacts is discussed and possible alternatives to CDD suggested. Finally, recommendations for post-CDD treatment and artefact storage in the field are proposed.

1 Introduction

Cyclododecane (CDD) is a subliming hydrocarbon ‘wax-like’ substance, which has been found to have extremely useful applications in the heritage conservation field (Salzmann and Hangleiter, 2005). The aim of this paper is to review its use by conservators at the site of Abydos, over an almost 20-year time period. We will describe some past and recent applications of CDD at Abydos and the practical developments of the application method. Our work builds upon contributions made by previous conservators – especially Sanchita Balachandran – whose work in the field at Abydos between 2002 and 2005, greatly facilitated through the application of CDD, is outlined in [Balachandran \(2010\)](#).

Abydos, in Upper Egypt, is located approximately 400 km south of Cairo and 10 km from the banks of the Nile. Abydos enjoyed a rich ancient history for almost 4 millennia, from the early dynastic period (approximately 3100 BCE) to the Roman period (641 CE). It was a burial site of early kings, and later became an important cult centre for the god Osiris, a ruler of the land of the dead ([O’Connor 2009](#): 31–41). During the New Kingdom period (16th–11th centuries BCE), pharaohs such as Seti I and Ramesses II built monumental temples on the edge of the desert plain, at Abydos.

2 Excavations

Many renowned archaeologists have excavated the cemeteries and city of Abydos, the first of whom,

Auguste Mariette, founded the Department of Antiquities in Egypt and the Egyptian Museum in Cairo. Mariette’s work was followed by Émile Amélineau who is known for digging at the Royal Tombs at Abydos, but he worked in a time when scientific methods of excavation and conservation were not established. Amélineau was heavily criticised by the archaeologist who followed him, Flinders Petrie, who excavated at Abydos around the turn of the 20th century. Petrie accused Amélineau of very poor record keeping and wilful destruction of artefacts that were not deemed worthy of sale or museum display, in order to prevent anyone else obtaining them. In contrast, Petrie was a pioneer of scientific archaeological methodology and well aware of the fragility of archaeological remains and the essential duty of the archaeologist for conservation of finds – even if he never mentioned the term conservation specifically, instead using the word ‘preservation’ ([Petrie 1904](#)).

Currently, many archaeological missions are working in various areas of Abydos, including the Universities of Michigan, Pennsylvania and Chicago, the German Archaeological Institute, and our team, the Institute of Fine Arts, New York University Expedition to Abydos (IFA-NYU). Building upon the legacy of Flinders Petrie, the current missions at Abydos incorporate advancement of conservation practice as an integral part of modern archaeological practice.

Archaeological remains from excavation sites such as royal tombs and temples are scattered



Figure 1 Abydos boats, dating from 3000 BCE. Photo courtesy of the Institute of Fine Arts, New York University Abydos Expedition.

over an 8 km² area (O'Connor 2009: 23). Countless artefacts have been found in these sites, in varying state of preservation and in a variety of forms and materials, including wood, bone and ivory, vegetable fibres, ceramic, metal and stone. Some of the most uniquely well preserved are animal and human remains, many of which are mummified.

3 The introduction of CDD to Abydos

CDD was first used in Abydos in 2000, when the Pennsylvania–Yale–IFA–NYU team conducted preliminary conservation treatment of boats and boat graves from the 1st dynasty (3000 BCE). It was intended as a pilot study for possible future excavation and conservation.

The 14 boat graves in Figure 1 were discovered in 1988 and confirmed in 1991 by the team led by Dr David O'Connor. The enormous wooden hulls, enclosed by mud bricks approximately 19–29 m long and 3.5 m wide, are arranged side by side in an area approximately 60 m long. These are located north-east of a large mud-brick funerary cult-enclosure called Shunet el Zebib, which dates from the 27th century BCE (O'Connor 2009: 185–188).

In 2000, the field director Dr Matthew Adams re-excavated a section of one of the boat burials with the intention of lifting the boat from the pit, and conservators Deborah Schorsch and Lawrence Becker came to Abydos to facilitate the lifting and stabilisation of the planks.

The section of the boat that was lifted was built from wood of an (as yet) unidentified species. It had suffered from brown rot, causing checking (where it breaks into cubic pieces), and it showed extensive termite damage (Blanchette et al. 1994: 3–5;



Figure 2 Conservation of one of the Abydos boat hulls using CDD. Photos courtesy of the Institute of Fine Arts, New York University Abydos Expedition.

Blanchette 2000: 191). In order for the conservators to lift the exposed planks from the trench for further examination and materials testing, CDD was used (Figure 2). Application of CDD in the field or even in museum conservation labs was then still new.

The site conservators established that CDD was the only material that would be practical and relatively simple and safe to use, even in the intense heat of the desert. It was strong enough to support the planks, could be applied and removed in a controlled manner, and had no undesirable interactions with Paraloid B-72 or with the solvents that would be used in the lab for long-term stabilisation.

Nevertheless, using CDD on site at Abydos without electricity, under the harsh conditions of extreme heat and aridity, was a challenge. A portable butane gas burner (used by the local Egyptian work-

men to heat water for tea) was brought to the site and used with a double boiler to melt the CDD. A temporary screen was devised to shelter the newly excavated planks from the wind and protect them from the drying heat of the sun (Schorsch 2015).

Paraloid B72 (3% in 3:1 acetone:ethanol) was used locally as a consolidant while CDD was applied to strengthen the individual planks and, in some cases, to adhere facings of Japanese tissue. When the planks were strong and rigid enough to be moved, they were turned over and similarly treated on their undersides. When fully consolidated, the planks were carried to the lab in wooden crates.

Once in the lab, the CDD was allowed to sublime, aided by fans, and the planks were more thoroughly treated with Paraloid B72, (3% in 3:1 acetone:ethanol). The wooden planks were placed on cushions made from cotton batting wrapped in non-woven polyester, inside wooden boxes lined with Marvelseal (aluminium–polyethylene and nylon sheet) to inhibit sublimation of the CDD and to maintain a relatively stable relative humidity. The planks have been monitored in subsequent seasons and found to be stable.

4 Examples of CDD use at Abydos

Since this trial field application in 2000, conservation teams in Abydos have been using CDD, both in a solution and more often in a melted form, on inorganic and organic materials. It has been used for both short-term and long-term treatment of artefacts between seasons and sometimes for many years afterwards. CDD is mainly used as a temporary consolidant, as an adhesive, and as a coating for surface protection for transportation and its previous use is described in depth by Balachandran in several case studies (Balachandran 2010). Following are some new examples of how CDD has been used and a critical review of past and present treatments.

4.1 Setup for using CDD in the field

Our setup for melting CDD while working outside in the field – using a portable butane gas burner and double boiler – has been updated in recent years to improve safety. Rather than heating the CDD directly over a burner (as was sometimes done previously at Abydos), the can is now heated inside a double water boiler made from a conve-



Figure 3 Conservation of stone blocks from the Osiris Temple. Photos: Hiroko Kariye.

niently close-fitting saucepan. The added benefit of this system is that the pan has a handle that remains cool enough to handle, and the CDD remains molten for longer because it is insulated by the surrounding hot water.

When working with CDD inside the lab or in the storage area, we are able to melt CDD rapidly inside a heatproof beaker, using an electric water kettle as a double boiler (we use the kind of kettle where the heating element is below a flat plate at the bottom). The kettle is only half-filled with water, and the heatproof beaker of CDD placed inside with the lid closed. The water in the kettle can be re-boiled until the CDD is melted. CDD stays workable for 10–15 minutes if kept in the hot water.

4.2 Protecting fragile surfaces for transport

Ten blocks with painted relief decoration from the New Kingdom (16–11th centuries BCE) were excavated in 2003–4 from the site of Osiris Temple. Many of the blocks had suffered since excavation, from improper handling and during transport from the excavation site to the Egyptian Antiquities Department storage, approximately 50 km away. This resulted in breaking and cracking. In addition, improper storage conditions had accelerated active soluble salt deterioration. The pigments were friable and the surface was actively exfoliating and flaking.

In 2012, the blocks were treated with CDD in advance of possible transportation back to the on site



Figure 4 Block-lifting artefacts from a canine animal mummy pit. Photo courtesy of the Ahmose and Tetisheri Project, Pennsylvania–Yale–IFA–NYU Expedition to Abydos.

storeroom at Abydos. Melted CDD was applied directly over the undecorated surface for protection during transport. Where necessary, fragile decorated surfaces were consolidated with Paraloid B72 and faced with Japanese tissue prior to application of CDD. All cracks, exfoliating breaks and vulnerable edges were faced with cotton gauze and CDD, and the individual blocks were wrapped in polyethylene foam and placed on cradles for ease of movement.

4.3 Lifting objects from a trench

We often use CDD for lifting artefacts from a trench since it is almost impossible to block-lift artefacts in the loose desert sand using traditional methods such as compacting the soil around artefacts and taking out a soil block (Balachandran 2010: 78 and personal experience of the authors).

It is useful to be able to move an artefact from a trench quickly in order for an archaeologist to continue excavation. This also allows researchers to work on artefact clusters at their own pace and conservators to treat an artefact under a more controlled environment in the lab.

A large pit, discovered in 2004 in South Abydos, had inside it a large number of vegetable fibre mats covering and wrapping fox, jackal and



Figure 5 Block-lifting vertical coffin walls at Tel el Amarna. Photo: Lucy Skinner.

dog mummies. The deposit dates probably to the Graeco-Roman period (c. 2nd century BCE–2nd century CE). The majority of the deposit is still in the pit, apart from some large vegetable fibre mats that were block-lifted from the ground using CDD, the conservators working by dangling over the pit on wooden planks (Figure 4). Cotton gauze was laid over the matting and adhered to it using molten CDD. The block was turned over after lifting and laid gauze side down inside a fibreboard box, over plastic sheeting.

Five years after excavation, the large oval-shaped mat remains in very good shape. The box was not airtight so the CDD has now sublimed, leaving an artefact that is secure and uncontaminated.

4.4 Lifting vertical coffin walls

The successful excavation of deteriorated painted wooden coffins in Egypt is particularly challenging. At the site of Tel el Amarna, the conservation team has developed a method of successfully consolidating and block-lifting the vertical walls of coffins using CDD (Figure 5).

The method – which was tested out first on the back wall of the excavation house, using a variety of application methods and facing layers – involves pre-consolidating the plaster/wood substrate with 3% Paraloid B72 in 50 : 50 acetone : ethanol, followed by two applications of CDD. The first layer is made from melted CDD with 5% white spirit added. This solution is painted on to the vertical surface using a soft, warm brush. The addition of the solvent aids deeper penetration, strengthening the substrate and limiting the amount of CDD wasted from dripping off the coffin surface onto the sand. The second application is of pure melted CDD, applied

with a brush that has been warmed by resting it in the solution while the crystals melt, and is painted onto overlapping sheets of cotton gauze laid on the surface (Dawson and Skinner 2012). The same technique has been used successfully at Abydos on two Middle Kingdom coffins (Skinner *et al.* 2017).

4.5 Excavating human remains

In cases where we need to excavate entire mummies and desiccated human remains in one piece, we have found CDD to be particularly useful. There are certainly simpler or cheaper options, but the advantage of CDD over other techniques is that it avoids contamination of biological remains with polymers or resins that can destroy their potential for future analysis (Wills *et al.* 2014: 50).

During treatment of a naturally preserved baby mummy (Figure 6), the local temperature measured 40 °C and, when applied to the skin, the CDD took a long time to turn from liquid to solid, allowing the formation of very large crystals. Interestingly, these long, needle-like crystals of CDD, when left uncovered in the warm conservation lab, were very fast to sublime and had disappeared from the surface within only one week, which is much faster than usual. This is probably due to the enlarged surface area and increased porosity of the CDD layer created by these crystals, resulting in increased sublimation rate. It is a tendency that could potentially be exploited to speed up the follow-up treatment of objects coated in CDD.

The ability of CDD to adhere things together was exploited in the treatment of a human skull. This particular skull still has hair, two strings of beads around the neck and skin still preserved over the chest area (Figure 7). The lower mandible was open and loose, and skin and beads in the neck area were vulnerable to damage. CDD was used to immobilise the chest area with the beads, and a ball of gauze strengthened by impregnation by CDD was placed inside the mouth to hold the jaw firmly in position while it was block-lifted; this created a rigid and reliable support for the human remains.

4.6 Packaging for long-term storage

In both the next and the previous example, conservation included the construction of supportive packaging and placing the human remains within a protective (but not airtight) fibreboard box. Fol-



Figure 6 Block-lifting a naturally preserved baby mummy using CDD: a) before treatment; b) during treatment; and c) after treatment. Photos: Lucy Skinner.

lowing several years in storage, the CDD has now sublimed. The cushioned supports cradling the remains on a rigid wooden board have ensured that neither of the artefacts collapsed or became damaged after the supportive coating of CDD had disappeared.

The example shown in Figure 8 is a New Kingdom cartonnage mummy case that was excavated in 2006 and block-lifted using CDD, and which is described by Balachandran (2010: 83). At the time of excavation, the CDD-coated pieces were carefully wrapped in polyethylene sheeting, padded with



Figure 7 Consolidating and adhering human remains in the field: a) during treatment; and b) after treatment. Photo courtesy of the Institute of Fine Arts, New York University Abydos Expedition.

foam for support and placed directly into a wooden box lined with Marvelseal. This created a virtually airtight package with very little space for air circulation. Over nine years later a significant layer of CDD still remains coating the cartonnage and the object's condition is unchanged. Several CDD crystals have evidently sublimed and, due to the limited air circulation, re-deposited on the surface of the polyethylene wrapping and the Marvelseal box lining. The CDD layer remaining on the cartonnage has a slightly sugary texture and appearance. Although difficult to prove, the CDD appears to have lost volume and is probably not imparting as much strength to the cartonnage as it once did.

In an ideal situation, the mummy case would be removed from the packaging and a more long-term solution found to conserve it. However, for now it remains a useful example of a case where CDD has been in contact with pigments, plaster and other ancient materials for an extended period of time, and it is part of a monitoring program. Keeping track of long-term changes in the object (pigments and plaster), its condition and the appearance of the



Figure 8 Cartonnage sarcophagus case in airtight packaging. Photo: Lucy Skinner.

CDD coating will be very informative.

5 Condition survey of objects treated with CDD

A survey form was created using the Filemaker Pro program, in order to document all objects in the storerooms at Abydos that had been treated in any way using CDD. So far over 50 artefacts have been examined and assessed. These fall into three main categories:

1. Artefacts coated in CDD during field conservation, for temporary consolidation and protection during block-lifting or transport. For these objects, the CDD was allowed to sublime in the lab, and the treatment completed (using conservation grade materials) before the artefact was put into storage. These artefacts required no further conservation treatment.
2. Artefacts treated with CDD as above, but

where the excavation season finished before the CDD could sublime. These were placed in air-permeable boxes but supportive cushioning and packaging were provided, and the CDD was allowed to sublime naturally in the storeroom between seasons. These artefacts required minimal or no further conservation treatment.

3. Highly fragile or vulnerable artefacts that were impregnated and block-lifted using CDD, then wrapped and placed in airtight packaging to obstruct sublimation of the CDD. Sublimation was hindered in this way so that any changes to the artefact could be monitored and controlled over time. The survival of the artefact is thus ensured and if it is found to be too deteriorated to self-support once the CDD support has been removed in a controlled environment, alternative, more permanent methods of consolidation can be employed.

For objects falling into the first two categories, the survey has found that the CDD has sublimed without trace, except where airflow has been obstructed (for example, on the base of an object where it is in direct contact with an impermeable material such as aluminium foil or thick plastic sheeting). After the CDD has sublimed, gauze or tissue facings can be lifted off and no residue remains on the object. These treatments are considered successful. The only issue encountered is where the substrate is fibrous and becomes caught in the cotton gauze facing layer when it is removed.

For objects in the third category, the types of wrapping and packaging used have varied over the years, both in material and in their degree of success in preventing sublimation. The types of packaging used include:

1. Airtight storage in wooden boxes lined with Marvelseal, used for artefacts that had been treated with CDD after block-lifting. The CDD lasts 3–4 years, depending on the thickness applied. It seems to disappear almost completely in 4–5 years.
2. Tyvek wrapping and polyethylene bags, neither of which has proved very effective at retarding CDD sublimation.

3. Close wrapping of the artefact in aluminium foil and/or polyethylene, followed by close packing in Marvelseal-lined boxes. This method is very effective at retarding sublimation and a significant layer of CDD remains after 10 years.

It has become clear that, despite the fact that CDD is volatile, if airflow and the volume of air near the CDD layer are restricted, it will last an exceedingly long time without subliming, even if the temperature is high. Conversely, where there is relatively low airflow but a lot of space – within a fibreboard box for instance – after a year, the CDD will have almost completely sublimed, without trace.

For instance, CDD is not prevented from subliming if it is placed in a Marvelseal-lined box, whereas sublimation will be retarded if the object is closely wrapped, even if the wrapping material is quite permeable (e.g. polyethylene). Another observation made during the survey was that CDD sublimation is slowest from grooves, cracks and on the base of objects.

While conducting the survey it was noticed that, where CDD has lingered for multiple years on surfaces, its texture appears to change, becoming grainier, and less solid in appearance.

Finally, the survey revealed that, in all cases where CDD has purposefully been allowed to sublime, it has done so, leaving no visible trace. By all accounts it appears to leave no chemical contamination for future analysis (Stein *et al.* 2000). It is possible that there are some residues – not of the CDD itself, but trace amounts of other materials mixed in to the CDD supply, from brushes or containers used to melt it – but these are negligible (Caspi and Kaplan 2001: 119–120).

During the survey, as well as discovering successful treatments we also encountered some failures. In the example shown in Figure 9, CDD was used during a previous season as a facing for a small fragment of painted stucco, to allow it to be removed safely from the ground. The fragment was wrapped in Tyvek, placed onto Plastazote foam (but not a rigid support such as Corex or a wooden board) and double bagged in polyethylene Ziploc bags. The original intention of the conservator (as written on the conservation label) was that the treat-



Figure 9 Fragment of stucco, disintegrated inside packaging. Photo: Lucy Skinner.

ment be followed up and completed the following year. However, this did not occur. Unfortunately, the artefact was not properly immobilised and the polyethylene bags did not provide an adequate barrier to sublimation. As a result, the CDD sublimed before treatment could be carried out, leaving the object unsupported. During the years between block-lifting and the CDD condition survey, the object was moved around in the storeroom. Without adequate support, and in the absence of sufficient warning on the packaging, the stucco crumbled to a condition beyond repair. This situation could have been avoided first of all by providing adequate support beneath the stucco; and, if there was time during the excavation season, by facing up the stucco with CDD followed up by consolidation and adherence of a permanent backing that would have supported it once the CDD had disappeared.

6 Issues concerning the use of CDD in the field

As conservators working in Egypt, we try as much as possible to purchase materials locally due to the cost and inconvenience of importing chemicals and equipment into the country, and in the interests of sustainability. One drawback of CDD is that it is currently unavailable in Egypt and is prohibitively expensive for most local conservators to purchase or to import. At Abydos, we always used to ensure we had a large supply of CDD, imported from the USA. In some cases, CDD has been used for block-lifting objects when alternative methods may have been equally or more appropriate for the purpose.



Figure 10 Feather terminals: unsublimed CDD has obstructed treatment with Paraloid B72. Photo: Lucy Skinner.

For example, during 2009, three blocks containing ibis bird remains and eggs were lifted. The first block was removed using CDD, and for the second one we decided to try Gypsona plaster bandages instead, employing a barrier layer of plastic wrap. Not only were the bandages much less costly than CDD, they are also easily available in Egypt. Upon review, the bandage method was determined to be equally if not more effective, and a faster method of block-lifting this kind of artefact cluster.

Another problem with CDD is that, once it has been used, it is not easy to carry out immediate treatment on the object. This can be especially problematic for field conservators working abroad since time is limited and there is often no guarantee that conservators will be able to return and resume work in the following year(s). **Figure 10** shows two painted wooden feather terminals that were lifted from a site using CDD. After a few weeks subliming in the lab, the CDD was still present during the last few days of the season. Application of Paraloid B72 to the pieces at this stage resulted in insufficient penetration and, when the treatment was re-assessed after 2 years, the CDD had sublimed, leaving a weak and hollow structure that had slightly caved in.

An honest review of the treatment has concluded that the artefacts should have been pre-consolidated with Paraloid B72 while they were still in the ground. Only after the solvent in the consolidant had evaporated should CDD have been applied; the artefacts would then be ready for block-lifting and could be put in storage without concern for their condition in the mid- to long term.

In order to find a solution to this problem of the slow sublimation rate for CDD, field tests were carried out using a faster-subliming volatile binding medium (menthol) as an alternative to CDD. Unfortunately, the melting point of menthol was so low (31 °C) that, when the melted solution was applied to the test panels (which were being treated outside the lab, in the sun), it did not solidify, therefore offering negligible strengthening effect. The menthol eventually hardened once the fragments had been brought inside the cool lab. This means that menthol would be completely ineffective as a consolidant for artefacts while in the field (at least in very hot countries, such as Egypt). In addition, while menthol has a pleasant odour in moderation, it rapidly becomes overwhelming to the eyes and nose, causing discomfort and irritation.

Other concerns involve the effect of CDD on a fragile substrate: firstly, that the application of heated CDD might cause damage to paint or ground layers; and secondly, whether CDD crystals forming within a porous surface as it sets or as it circulates from solid to gas within a sealed enclosure could cause some microscopic disruption of surfaces. Thus far, at Abydos, we have not seen any adverse effects caused by either of these possibilities, and experiments undertaken at SUNY Buffalo State by Nicole Peters suggest that CDD crystals do not have any significant effect on porous plaster and pigments (Peters *et al.* 2018). Extra caution should be taken when CDD is used out in the field. During sublimation, melted CDD applied to fragile surfaces with or without a facing could cause damage. When it is applied, the weight of CDD could be enough to pull off a loose surface. For objects where pre-consolidation is not possible or desirable, surfaces may fall off after sublimation, when they are no longer consolidated or strengthened by the CDD. Finally, once CDD has partially sublimed, a facing may begin to peel away by gravity or when blown by the wind, potentially taking a fragile surface with it.

7 Conclusion

In summary, CDD has been an incredibly useful addition to the range of materials we use in the field at Abydos and many objects would not have withstood excavation without it. With CDD, we

can work in the field more efficiently and fluidly to produce tangible results. Successful 'in-field treatments' using CDD have, without doubt, helped to gain respect for the work of the conservation lab, strengthening working relationships within the archaeological team.

CDD allows us to earn time, leaving room in the future for a better solution to a challenging conservation problem, should one arise.

In an ideal world, we would already have the perfect solution and perfect conservation treatment for fragile material in the field at sites like Abydos. Until we do, we will continue to learn from previous experiences and adapt our methodology in order to safeguard fragile artefacts. As an alternative VBM, menthol might be useful for block-lifting in cooler climates but in Egypt it is highly impractical. Therefore, provided one can obtain CDD at a reasonable price, we will continue with its use at Abydos and we are adapting our methods to find ways to increase the sublimation rate.

From monitoring the objects treated with CDD at Abydos over the past fifteen years, the most critical things we have learned are that:

1. Some barrier materials are better than others at blocking sublimation. Wrapping or encasing the object tightly in aluminium foil and tightly wrapping it in polyethylene, rather than using spacious boxes lined with barrier film such as Marvelseal, is most effective technique.
2. Packaging and post-excavation treatment of the artefact is critical. If CDD is to remain on the artefact surface while in storage, the artefact needs to be sufficiently supported in case something happens to prevent the treatment being revisited. Proper labelling, with diagrams or photos of the object and notes on how it has been treated and packaged, should be attached on a storage box. This should reduce the number of times when packaging is opened unnecessarily (merely to find out what is inside) and, as a consequence, will slow CDD sublimation and help to protect the object from mechanical damage due to excessive handling.
3. If an alternative method for block-lifting an artefact would achieve the same results, this

should be given preference. CDD is expensive and not available locally.

4. Finally, artefacts treated using CDD should be regularly monitored to ensure there have been no adverse effects from the treatment. This will also help to strategise future site-specific treatments with CDD and storage methods.

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Biographies

Lucy Skinner is an archaeological conservator specialising in organic materials, particularly from ancient Egyptian and Nubian origins. She is currently enrolled in a PhD programme at the Institute of Creative Leather Technology at University of Northampton and the Departments of Scientific Research and Ancient Egypt and Sudan at the British Museum. The PhD is focused on ancient Egyptian and Nubian leather technology. She is a graduate of the Conservation Department at the Institute of Archaeology, University College London, where she earned an MA and MSc in Conservation for Museums and Archaeology in 2004.

Email: lskinner@britishmuseum.org

Hiroko Kariya was trained as an objects conservator at the Conservation Center, Institute of Fine Arts, New York University. She has worked in museums in the United States and on various archaeological sites, including Karnak temple and the Valley of the Kings in Egypt. Since 1996, she has been a project conservator for the Epigraphic Survey of the Oriental Institute,

University of Chicago in Luxor. Her current private practice work includes serving as a consultant at the Qatar National Museum, Harvard University's Archaeological Exploration of Sardis, Turkey, the New York University Expedition to Abydos, and for Waseda University in Egypt.

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